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STUDIES ON THE EFFECT OF ATMOSPHERIC RADIOACTIVE MATERIALS ON HUMAN BEING IN DIFFERENT PLACES OF EGYPT

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ABSTRACT

Living in nature, human cannot avoid the radiation. About 80% of all radiation is from nature, and 55% of natural is from radon (Rn) and radon progeny. So people have paid much attention to the biological harm, which is due to Rn and Rn progeny. The greatest fraction of the natural radiation exposure in humans results from inhalation of the heavy metals of short-lived decay products of radon (222Rn) and thoron (220Rn). To estimate the radiation dose due to the exposure to the short-lived radon and thoron decay products in the atmospheric air, one must know the amount and deposition place in the lung. For these dose calculations, three parameters of air activity are important: 1). Concentration of the decay products. 2). Concentration of the unattached fraction of the decay products. 3). Activity size distributions of the radioactive aerosols. Some recent studies on these processes have been done including our research activities, the main radioactive decay properties and the processes affecting concentrations. The radioactive aerosol size distributions and it is effect on the human being in different places.

KEYWORDS: Natural Radiation, Radon Progeny, Heavy Metals, Radioactive Aerosols and Aerosol Size Distributions

INTRODUCTION

Radon and thoron of uranium and thorium decay chains noble gases produced by decay of 226Ra and 224Ra, respectively. These gases can leave the earth's crust either by molecular diffusion or meteorological processes. The radon and thoron decay products are radioactive isotopes of polonium, bismuth, lead and thallium which are produced by decay of the radon isotopes. These daughters of the radioactive gases are isotopes of heavy metals are easily fixed to the existing aerosol particles in the atmosphere. They decay by alpha particle and beta/gamma emission. The elimination of these radionuclides from the atmosphere occurs either by radioactive decay or by removal processes (dry deposition, rainout, washout). The "radon problem" was first recognized among workers in miners may be attributed to the high radon concentration between 103 and 5x104 Bqm-3[1]. It took another 30 years to recognize that the true for higher lung dose is not the radon but from the inhalation of the heavy metals of short-lived radon daughters RaA (218Po), RaB (214PB), RaC (214Bi) and RaĆ (214PO)[2]. These radioactive atoms, formed by the decay of radon in the air, are mostly adsorbed on the surface of atmospheric aerosol particles. During inhalation the radioactive aerosol particles are accumulated in the lung by filtration. Therefore, the lug is exposed to higher radiation doses than other organs of body. The aim of the present work is contribution with our research to the recent activities, the main radioactive decay properties and the processes affecting concentrations. The radioactive aerosol size distributions and it is effect on the human being [3].

MATERIALS AND METHODS

To determine the concentration of attached short-lived 222Rn progeny in the air, the radionuclides attached to aerosol particles were collected on membrane filters (Sartorius membrane filter type SM, 1.2 µm pore size, 25mm diameter and collection efficiency of 100%) using a sampler with an air-flow rate of 2m3h-1. During the measurements, the aerosol particle concentration was monitored by a condensation nuclei counter (General Electric TSI, Model 3020). The counter can be used for determining aerosol particle concentration in the range from below 103 up to 107 particle cm-3.

Simultaneously, the local meteorological data (relative humidity, air temperature and wind speed) were recorded continuously using weather station (Davis Intruments-7395). The values were obtained every second and averaged for 10min intervals. For determination of the specific air activity concentrations of 210Pb and 7Bi, 120 samples were taken over the whole year (the filter was changed twice a week). Round glass fibre filters (125mm diameter) with collection efficiency of 99% for retaining aerosol particles were used. The air was sampled through the filters with flow rate of 25m3h-1. The sampling station is located on the roof (20m above ground level) of the Physics Department, Faculty of Science, El-Minia University.

For the determination of the deposited aerosol mass, the filters were weighed under controlled conditions (Mettle, Analytical balance, AE 240 Dual Range Balance) before and after air sampling. The difference between the two weights gives the deposited aerosol mass. The specific aerosol mass concentration in gm-3 was determined as v=m/Q1 where m is the deposited aerosol mass on the filter (µg). The obtained values of total deposition and the present measurement of activity concentrations have been substituted into a LUDEP 1.0 personal computer program RPB-SR 264 [4] to calculate the annual effective dose through the human lung.

RESULTS AND DISCUSSIONS

The dominant component of natural radiation dose for the general population comes from the radon gas 222Rn and its short-lived decay products, in the breathing air. Radon-222 is responsible for more than 40% of the total background radiation dose and 90 percent of the background radiation dose to the human respiratory tract. Radon-222 exposure at high levels produces biological changes that are postulated to be important during the process of cancer induction [5]. The solid air borne 222Rn progeny, particularly 218Po, 214Pb and 214Bi, are of health importance because they can be inspired and retained in the lung. The radiation released during the subsequent decay of the alpha-emitting decay products 218Po and 214Po delivers a radiological significant dose to the respiratory epithelium [6].

The measurement of the radionuclide concentrations in the various organs of the human body is still critical to the estimation of the internal radiation dose. A program to assess the concentration of radionuclides in the human body is difficult to implement due to many ethical and cultural restrictions. Investigators in many countries have found that working with the local medical examiner, coroner, pathologist or teaching hospital provides a means of obtaining tissues [7]. It is often difficult to establish certain fact which will affect the concentration of the radionuclide in the body. These include the length of time of residency in the area as well as life style such as occupation and smoking habits. The age of 15 years and substantially more over the age of 60 years. In many studies of radionuclide incorporation in the human body, the soft tissues of most interest are lung, liver and kidney [8].

The lung doses equivalent and effective dose equivalent for occupational workers were calculated in three different places in Egypt (Inchass, Cairo and El-Minia City and in three different mines located in the Eastern Desert about 500 Km south of Cairo). The obtained annual dose equivalent to the lung and the resulting effective dose equivalent attributable to the chronic indoor exposure to the long-term average radon daughters, Bq/m3, in three places in Inchass, Cairo would be 1.61 mSvy-1, respectively. In El-Minia city, the obtained results indicate that the unattached atoms are nearly completely (97%) deposited in the respiratory tract during inhalation, where are about 80% of attached exhaled without deposition i.e. about 23% only deposited [9].

The radiation dose has been calculated by using an appropriate dosmetric models. The calculated values [10] of dose conversion factor range from 0.02 up to 0.072 mSv.y-1 per Bq.m-3. In addition, dose equivalent conversion factor, for indoor radon, in El-Minia City, range from 7.98 for nasal breath to 13.1 mSv/WLM-1 for month breath [10]. The calculated values for nose breath are two times higher than the recommended values of ICRP [11] where 3.9 and 5.1 mSv.WLM-1 were published for the public and at working places, respectively. It can be estimated the total effective dose through the human lung due to the present measurements in the mines of interest is as follows, based on the values of the activity median aerodynamic diameter 0.25 µm and standard deviation 2.5 which is recommended by ICRP [12].

The annual effective dose due to the inhaled individual radon progeny (218Po, 214Pb and 214Po) show that, the dose from 218Po was higher than that from 214Pb and 214Po in all mines. In general, the present calculated dose exceeded the dose limit 20 mSv.y-1 (averaged over a period of 5 years with the proviso that the effective dose should not exceed 50 mSvy-1) as recommended by ICRP 60 [12].

CONCLUSIONS

For best estimation dose, on must have an accurate data for unattached, attached activity size distributions and concentrations of radon decay products. Therefore: i) a continues measurements should be should be done to get an accurate data ii) should be to do good calibration the equipments that were used in the measurements. In homes built with better insulation and better seals on windows and doors, radon has less chance to be ventilated to the outside and can become concentrated to dangerous levels in indoor air [13]. So, the ventilation is the most important in the reduction of radon decay products in room air. Also, the ratio of surface/volume (S/V) of the residential rooms is considered important in the reduction of the radon level in room air. A larger S/V ratio cause increasing the deposition surface by furniture [14].

It was found that a person living at a site with light-weight concrete as partition walls receives an average annual equivalent dose lower than one living at site with normal concrete. It means that the type of material that is used in building is considered another component to control the radon levels in room air.

In underground mines ventilation is the most effective method of minimizing the exposure to radon and its decay products. Sufficient fresh air should be provided to each working area [15]. Main mine ventilation and dust control systems should be operated continuously. Preferably the ventilation system should be designed as a pressurized system. This minimize gas seepage from unventilated mined-out area of clean air. Furthermore over-pressurization decreases radon and thoron emanation from the surrounding rock into the shafts and tunnels.

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